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CWT and CS Algorithm Based Video Watermarking using Audio Watermark

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Abstract

To increase the robustness of the scheme, we have developed an efficient video watermarking scheme to embed audio watermark based on optimal location. Before embed the audio watermark in to the digital video, the input video sequence is segmented into shots using discrete cosine transform. The segmented video shots are partitioned addicted to number of frames for the embedding process. In this process the PSNR value calculated for each frames and select the best frame by using CS algorithm. The audio data is utilized as a watermark to embed into the digital video sequence. Initially, the audio data is converted into 9 bit sequence and then it is encrypted. In watermarking embedding process, segmented video data is given to the Coiflets wavelet transform and the encrypted audio watermark data is embedded based on optimal location analysis that is carried out using CS algorithm. Later, the original audio data is extracted from the watermarked video using the designed watermarking extraction procedure. The performance of video watermarking is analyzed in terms of various attacks.

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Keywords: *Video watermarking; 9-bit conversion;Audio video coding Standard;Embedding;Extraction.*

1. Introduction

In modern years, the usages of digital multimedia have gained a tremendous growth as a result of their benefits in efficient creation and storage, ease of sharing and communication. The advanced audio video coding standard is developed by the Audio Video Coding Standard Workgroup which aims to establish general technical standards such as the coding, decoding, dispensation and the Depiction of digital audio-video [1].

Nomenclature	
CS	Cuckoo Search
PSNR	Peak Signal Noise Ratio
NC	Normalized Correlation
CWT	Cofilets Wavelet Transform

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Video watermarking is relatively recent technologies that have been proposed to solve the difficulty of illegitimate manipulation and distribution of digital video. It is the process of embedding patent information in video bit streams [2].Due to a outsized quantity of information and inherent redundancies between frames, video signals are extremely liable to piracy attacks, include frame averaging etc [3][4]. Digital watermarking technology is very new technology that is used for the method of embedding information in a specific and realistic mode. Digital Watermarking can be viewed as visible and as well as invisible too. It can entrench copyright information into the multimedia information through certain algorithms; the in sequence may be author's serial numeral, concern logo, images or text with unique consequence, and so on. Their function is served as copyright protection, undisclosed communication, authenticity discriminate of data file etc**.** [5] Need of video watermarking issue is increasing every year by year, at the same time the complexity and adjustability of the solution space for the watermarking of video is remarkably greater than that of images because of the existence of time dimension even though video streams in the raw form are ordered sets of image frames, [6].

2. A Related Work

Sundararajan.M *et al*. [7] presented an efficient video watermarking technique using discrete wavelet transform to protect the copyright protection of digital images. Primarily, the input video sequence is segmented into the non-overlapping units called shots using well known shot segmentation technique.. Initially, the gray scale image is sliced into bit planes for analyzing the relative importance played by each bit of the image. Then, each permuted images are embedded into each frames of the segmented shots with the aid of the watermark embedding process. Subsequently, the recovery of the watermark is achieved with the assist watermark extraction process. It shows that our proposed video watermarking techniques provide better results with higher accuracy.

Puja Agarwal *et al.* [8] developed a digital video watermarking scheme that can insert unseen and vigorous watermark information into the video stream standards. It exchange between simplicity and vigour is considered as optimization problem and is solved based on hybrid optimization technique.

In present work, currently CS algorithm has been implemented due to the fact that several papers previously studied are lagging behind this concept. In this method watermarking embedding process, segmented video data is given to the Coiflets wavelet transform and the encrypted audio watermark data is embedding based on optimal location analysis are carried out using CS algorithm. Subsequently, the original audio data is extracted from the watermarked video using the designed watermarking extraction process. Evaluation metrics used are PSNR and NC.

3. A Technique of Video Watermarking Algorithm to Embed Audio Watermark based on Optimal Location

Before embed the watermark into the digital video sequences, the following process should carried out to improve the security of the hiding information as well as to develop the efficiency of proposed technique. The process comprises following:

- Shot segmentation process of input video sequence[7]
- 9-bit plane conversions of message audio data[8]
- Decomposition of shot segmented video using coiflets wavelet transform:

3.1 Finding optimal locations for embedding the watermark audio using CS algorithm

We utilize the CS algorithm to search for optimal steps, in order to optimize both the quality of watermarked image and robustness of the watermark image. CS algorithm is applied in the watermark embedding and the watermark extracting processes for the optimization process. The evaluation function of this process is computed by using factors such as PSNR and NC.The detailed explanation of finding optimal locations using CS algorithm is presented below:

3.1.1 Generation of nest:

To select the optimal location or best solution, initially the CS algorithm chooses the number of nest. Consequently, it assigns dimension to each nest randomly named as X_1 and X_2. Here, X_1 contains sound wave values and X_2 contains number of frames. The sound wave consists of 9 bit format (0 and 1) and the numbers of frames is based on the input videos.

3.1.2 Calculation of fitness:

The fitness value of the each nest helps to finds the best nest among the set of available nest. We have to concatenate those X_1 and X_2 and corresponding PSNR and NC value as fitness value to CS Algorithm. To calculate fitness of each nest, initially the CS algorithm calculates the PSNR and NC for find the initial fitness of the nest. With the help of initial fitness, CS algorithm calculates the final fitness of each nest. The fitness value calculates with following formula.

$$Fitness = PSNR + NC \tag{1}$$

3.1.3 Find best nest:

The position of the nest is based on the fitness value of equation (1). Then, the CS algorithm initialize for "***best nest***" by selects first value as "***best nest***" from the CS process. In every iteration, the value of best nest changes if the following condition is satisfied.

$$N_{best} = \begin{cases} best\ nest = N_{pre}\ ,\ if\ \ F(N_{prv}) < F(N_{cur}) \\ F(N_{cur}), \qquad\qquad else \end{cases} \tag{2}$$

Where, $F(N_{prv})$ is the fitness of previous nest, $F(N_{cur})$ is the fitness of current nest

3.1.4 Updating of nest with levy flights:

In the first iteration, the CS initializes value for the best nest. To find the optimum value of best nest (best solution) the algorithm changes value of nest at every iteration. To find the best solution, for the iterations the solution values (eggs) and dimension of the nest must be change. The levy flights technique helps to change the value of eggs and of every nest.

3.1.5.1Levy flights:

When generating new solutions for the i^{th}cuckoo, the following Levy flight is performed. The levy flights calculate step size (α) value to generate a new value of nest by adding the existing value of the nest. The old value of the nest $N_i(t)$ is replaced by new value $N_i\,(t+1)$ using the following equation 2.

$$Y_i^{t+1} = Y_i^t + \alpha \oplus Levy(\lambda) \tag{3}$$

$$Levy(u) = t^{-\lambda},\ 1 < \lambda \leq 3 \tag{4}$$

Where, λ is levy flight parameter, u is the local mean flow velocity (m/s)

3.2 Watermark Embedding Process

The watermark embedding process is explained in Fig. 1.

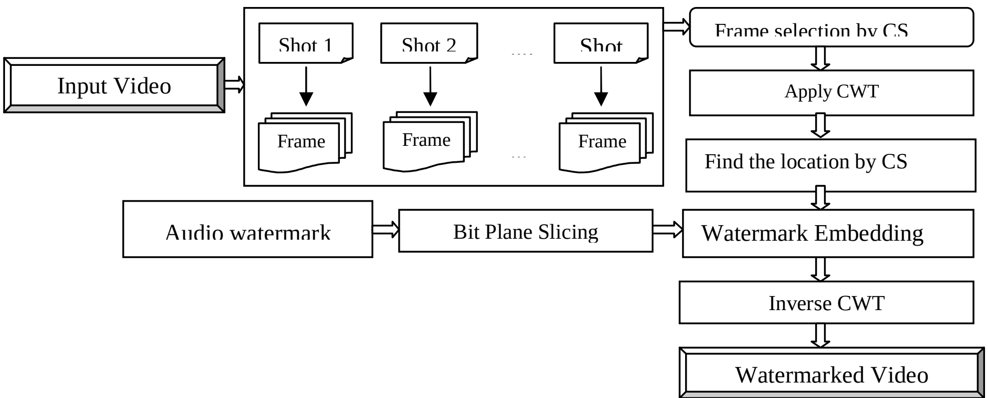

Fig. 1. Watermark Embedding Process

Step1: With shot segmentation method, the input video sequence is segmented into number of non-overlapping shots. Then, categorize the number of frames involved in every segmented shot for embedding purpose.
Step2: Slice the watermark audio into 9 bit planes using bit plane slicing.
Step3: For embedding the each sliced audio sample into the blue components of each frame, the blue components of all the separated frames are extracted.
Step 4: Decompose the blue components of every partitioned frame into four sub-bands with the aid of the coif lets wavelet transform to attain the transformed frames.
Step 5: To embed the audio, we have selected the low frequency sub-bands from the transformed frames.
Step6: Find the similarity matrix of the video to embed into the chosen sub-bands. The higher part of the similitude matrix is embedded into the HL sub-band and the lesser part of the similitude matrix into the LH sub-band.
Step7: In the HL sub-band, the higher part of the similitude matrix is embedded with the following steps: Calculate the fitness function of each possible location the CS Algorithm that is composed of the PSNR and NC values.
Step8: Choosing the maximum value of PSNR in corresponding locations and find the best nest and embed
Step 9: Embed the watermark bits 0 or 1 in a zig-zag manner in the chosen embedding part, since the watermark is the audio. There are two cases watermark audio bits
Case 1: for embedding the watermark bit '1'.

$$. \; if \; E_{p(i)} > 1 \; then \quad E_p[x,y] << Abs\,[E_{p(i)}] \quad else \; E_p[x,y] << E_{p(i)} + \max(E_p) \; end \quad if$$

Case 2: for embedding the watermark bit '0'.

$$if \; E_{p(i)} < 0 \; then \quad E_p[x,y] << Abs\,[E_{p(i)}] \; else \quad E_p[x,y] << E_{p(i)} - \max(E_p) \; end \quad if$$

Step 10 Update the nest with levy flights to get optimal solution by the equation (3) and (4)
Step 11: Similarly, the lower part of the similitude matrix is embedded into the LH sub-band. Also, each audio is embedded into all the frames of every shot.
Step 12: Divide all the embedded frames by means of the embedding strength to improve the quality of the video.
Step 13: Map the modified sub-bands into its original position and apply the inverse Coiflets wavelet transform to attain the watermarked video sequence.

3.3 Watermark Extraction Process

After embedding the watermark audio into the original video sequence, it includes extracted the embedded watermark audio message without affecting the original video. The watermark extraction process is explained below.
Step 1: Using shot segmentation technique, the input video sequence is segmented into number of non-overlapping shots. It identifies the number of frames involved in each segmented shots for embedding purpose.
Step 2: For extracting the embedded watermark pixels, the blue components of all the partitioned frames are extracted. Calculate the PSNR of the blue components of each frames
Step 3: Decompose the blue components of the frames with the aid of the coiflets wavelet transform into four sub-bands.
Step 4: To extract the watermark audio, the low frequency sub-bands from the altered frames are selected.
Step 5: Extract the watermark bits from the embedding part in a zig-zag manner from the HL and the LH sub-bands with the aid of the following steps. If the embedded bit value is larger than the fitness value, the extracted pixel value is one. If it is lesser, then the extracted pixel is zero.
Step 6: Form the matrix with the size of the watermark image and the extracted bits are placed in it to attain the watermark audio.
Step 7: By applying the reverse process of bit plane slicing, the watermark audio is obtained.

4. Results and Discussion

The replication results are carried out with diverse video sequences and the audio message as the hiding information. The technique discussed in the paper effectively embedded the watermark audio message into the original video sequence and extracted it back from the watermarked video sequence. The watermarked video sequences possess better PSNR and ocular superiority for audio message.. The visual quality is evaluated by the PSNR criterion in between the original video sequences with the watermarked video and the extracting dependability is compared by the NC value between the original watermark audio and the extracted watermark audio. The applicability of the present technique is established by the result obtained.

4.1 Simulation Results

The simulation results and the evaluation results of four video samples are given as below. Figure 2(a-d) depicts the Akiyo, Claire, Football, and Hall video sequence. Similarly, the figure 2(e-f), shows the watermark audio message and Extracted Watermark audio message.

(a) (b) (c) (d) (e) (f)

Fig. 2. (a-c) Input Akiyo,Claire, Football,Hall video sequence; (e) Watermark audio message; (f) Extracted watermark audio message

4.2 Robustness Results

Table 1 depicts the PSNR values of the Akiyo, Claire, Football and Hall video samples respectively. Here, the PSNR value for our technique is getting change while we are varying the frame numbers. Additionally, the NC values of the four video samples is correspondingly shown in table 1. The techniques have NC value for corresponding embedding strength with frame number. Table 2. Shows the computational time for four video sequence.

Table1. PSNR and NC with Number of Frames of Akiyo,Claire, Football, Hall video sequence

Video Sequence	Frames	Embedding Strength=1		Embedding Strength=5		Embedding Strength=10	
		PSNR (db)	NC	PSNR (db)	NC	PSNR (db)	NC
Akiyo	20	48.07	0..9906	44.33	0.9901	40.74	0.9912
	40	48.10	0.9894	43.31	0..9816	40.30	0.9810
	60	46.59	09889	45.99	0.9784	42.47	09797
	80	44.90	0.9912	47.97	0.9887	42.89	0.9884
Claire	20	46.93	0.9787	46.27	0.9746	44.94	0.9737
	40	44.19	0.9741	42.63	0.970	42.11	0.9740
	60	46.07	0.9754	41.41	0.9721	39.56	0.9712
	80	44.74	0.9707	43.85	0.9738	41.91	0.9701
Football	20	40.84	.9659	37.02	0.9627	37.10	0.9648
	40	44.07	0.9628	41.67	0.9633	36.80	0.9628
	60	39.78	0.9584	39.57	0.9652	34.83	0.9594
	80	38.30	0.9695	41.95	0.9632	35.62	0.9699
Hall	20	39.22	.9592	38.18	0.9673	35.10	0.9669
	40	38.80	0.9599	38.92	0.9660	36.25	0.9654
	60	39.65	0.9552	36.34	0.9652	36.62	0.9688
	80	40.93	0.9631	37.34	0.9657	34.88	0.9679

Table 2. The computational time for CWT and CS algorithm based scheme

No of iterations	Computational time of Akiyo video(s)	Computational time of Clarie video(s)	Computational time of Football video(s)	Computational time of Hall video(s)
0	20	22	23	24
25	25	27	29	28
50	54	53	55	57
100	103	106	109	112

4.*3 Comparative Analysis*

In this present work, we have compared proposed video watermarking technique against existing work (Puja Agrawal *et al.* [8]). The performance of the proposed video watermark technique is analyzed with the help of PSNR and NC. Here, we have taken two video samples for simulation. The result using Akiyo and Claire are illustrated in table 3. The proposed technique gives more effective results than the existing technique (Puja Agrawal *et al.* [8]). In this section, the proposed algorithm is tested for different attacks such as salt and pepper noise, cropping ratio and rotate. The proposed video technique shows better results when compared with the existing techniques.

Table 3. Performance Analysis PSNR and NC for Various Attacks

Video Sequence	Attacks	Puja Agarwal Existing[8]	Proposed	Puja Agarwal Existing[8]	Proposed
		PSNR (db)	PSNR(db)	NC	NC
Akiyo	Without Attacks	35.5613	46.1023	.99209	.99312
	Salt and pepper(.001)	35.3612	45.9863	.98659	.99120
	Salt and pepper(.02)	35.3609	45.9402	.98659	.99116
	Cropping	35.4617	45.9703	.98985	.99001
	Rotate (90)	35.4617	45.9621	.98985	.99030
	Rotate (180)	35.5222	45.9402	.98814	.98910
	Rotate(270)	35.5271	45.7943	.98898	.98960
Clarie	Without Attacks	32.9895	45.2107	.96750	.9817
	Salt and pepper(.001)	32.9889	44.9124	.96750	9805
	Salt and pepper(.02)	32.9889	44.8765.	.97265	.9823
	Cropping	32.9895	44.8714	.97265	.9812
	Rotate (90)	32.9486	44.8472	.95090	9857
	Rotate (180)	32.9628	44.8120	.92880	.9786
	Rotate(270)	32.9474	44.8023	.92530	.9648

5. Conclusion

In this paper, a video watermarking technique to embed audio watermark based on optimal location, is presented. The proposed approach is robust against widespread geometrical attacks for instance, Salt and Pepper attack, Rotation and Cropping. This proposed watermarking scheme can further be associated with diverse applications to achieve a refined system and the fidelity can be improved by applying CS algorithm. The scheme can be improved by making use of the information from the video, such as instant information, to enhance the robustness of the watermark.

References

[1] Xingguang Song, YutingSu , Yu Liu , ZhongJi.,2008." A Video Watermarking Scheme for AVS Based on Motion Vectors ," *IEEE conference on ICCT*, Hangzhou, p.738-741

[2] Lama Rajab, Tahani Al-Khatib, Ali Al-Haj. Video Watermarking Algorithms Using the SVD Transform *European Journal of Scientific Research*,2009;p.389-401

[3] PikWah Chan, Michael R. Lyu and Roland T. Chin, "A Novel Scheme for Hybrid Digital Video Watermarking:Approach, Evaluation and Experimentation", *IEEE transactions on circuits and systems for video technology*, 2010; p.1632-1649

[4] Joo Lee and Sung-Hwan Jung, "A survey of watermarking techniques applied to Multimedia", *In Proceedings of IEEE on ISIE*, 2001; p.272-277

[5] Karen Su, DeepaKundur, DimitriosHatzinakos, "Statistical Invisibility for Collusion- Resistant Digital Video Watermarking", *IEEE Transactions on Multimedia*, 2005; p.43-51

[6] Nirankar Sharma, Deepak Sharma, Jitendra Sharma,. Digital Watermarking and Its Related Issues *International Journal of computer science and information technology*, 2011; p.166-170

[7] M.Sundararajan, G.Yamuna,. A wavelet based scheme for video watermarking *International review on computers and software* 2013; p.1023-1032.

[8] Puja Agrawal, Khurshid A. A., 2014. "DWT and GA-PSO Based Novel Watermarking for Videos Using Audio Watermark," Advances in swarm intelligence, ICSI, Hefei, China,p.212-220